Winter rye cover crop seeding date and rate impact on soil, weeds and soybean, Carrington, 2020.
(Greg Endres and Mike Ostlie)

The field study is being conducted at the NDSU Carrington Research Extension Center with support from ND Soybean Council to examine impact on soil, weeds, and soybean with winter rye seeded at two fall dates and three rates grown as a preplant cover crop. Study objective is to identify the best combination of rye seeding dates and rates for reaching goals with the cover crop including soil management and weed control while maintaining high potential for soybean seed yield. Experimental design was a randomized complete block (split-plot arrangement for rye: main plot=seeding date; subplot=seeding rate) and four replications. The dryland trial was established with flax as the previous crop on a Heimdal-Emrick loam soil with 3.1% organic matter, 7.7 pH, 7 ppm P (Olsen; low), 229 ppm K, and 1.61 mmho/cm soluble salts (0- to 6-inch depth). 'ND Dylan' rye was direct seeded in 7-inch rows on September 26 and November 1, 2019 at seeding rates of 25, 50, and 75 lb/A. Early seeded rye reached the 2-leaf plant stage while late-seeded rye did not emerge at close of growing season. 'AG03X7' soybean was direct-planted into living rye in 22-inch rows on May 29, 2020. Rye ranging from tillering to boot stage (5- to 20-inch height) was terminated after soybean planting on May 29 with glyphosate (Roundup PowerMax at 28.4 fl oz/A) plus AMS+NIS (Blue Diamond at 0.5% v/v). Glyphosate plus AMS+NIS was applied on June 23 (V1-2 soybean growth stage) and July 16 (R2 soybean growth stage) across the trial for general weed control. NDAWN monthly rain (inches): May=1.18; June=1.23; July=5.0; August=1.06; September=0.13; and 5-month total=8.59. Soybean seed was harvested with a plot combine on September 17.

Averaged across rye seeding rates, early seeded averaged 761,720 plants/A with ground cover at 57% compared to late seeded at 385,130 plants/A and 19% ground cover when evaluated in May, 2020. Averaged across fall seeding dates, rye plant density and ground cover among the three seeding rates: 25 lb/A = 250,430 plants/A and 30%; 50 lb/A = 599,040 plants/A and 39%; and 75 lb/A = 870,810 plants/A and 45%.

Table 1 indicates rye plant density and ground cover, and weed control with the interaction of rye seeding dates and rates. Plant stand ranged from 162,210 plants/A (4 plants/ft^2) to 1,149,700 plants/A (26 plants/ft^2) with highest density obtained with early seeding at the high rate. Stand generally was reduced with late seeding date when comparing each seeding rate. Ground cover was similar among treatments though tended to be greater with early rye seeding due to generally greater plant density and more advanced plant growth. Soil moisture levels were not taken due to high topsoil moisture present throughout the soybean plant establishment period.

Table 1. Rye plant density and ground cover, and weed control with winter rye cover crop seeding dates and rates, Carrington, 2020.

Rye seeding treatment		Rye		Weed control			
		Plant density	Ground cover	Foxtail[2]		Kochia	
	Rate	(8-May)[1]	Visual (28-May)	28-May	22-Jun	28-May	26-Jun
Date	lb/A	plt/A	%	%			
	25	338,650	49	52	66	55	56
	50	796,822	58	56	62	79	66
26-Sep	75	1,149,701	63	71	70	83	70
	25	162,210	10	10	64	0	40
	50	401,257	19	10	65	0	57
1-Nov	75	591,925	27	16	64	0	28
CV (%)		19.5	12.2	40.3	14.9	42.3	28.2
LSD (0.10)		140,784	NS	NS	NS	NS	19

[1]Early seeded rye = tillering growth stage; late-seeded rye = 1- to 3-leaf stage.

[2]Green (majority of population) and yellow.

Primary weeds in the trial were green and yellow foxtail, and kochia (partial glyphosate-resistant population). The late-May evaluation of weed control was completed just prior to soybean planting followed by rye termination with glyphosate. Foxtail and kochia control occurred with the early seeded rye. The late-June evaluation of weed control, that was conducted during the period of POST glyphosate application for trial weed control, generally indicated minimal differences among rye treatments.

Table 2 indicates soybean performance with the interaction of rye seeding dates and rates. Soybean plant stand and development, and canopy closure were similar among rye treatments. Soybean yield, test weight, seed count, protein and oil percentage were similar among treatments. Soybean seed yield was excellent under this production system averaging 49.0 bu/A.

Table 2. Soybean response with winter rye cover crop seeding dates and rates, Carrington, 2020.

Rye seeding treatment		Plant						Seed				
			Emergence	Flower	Canopy closure (10-Aug; R5 stage)		Physiological maturity					
	Rate	Stand			Visual	Canopeo		Yield	TW	Count	Protein	Oil
Date	lb/A	plt/A	Day of year		%		Day of year	bu/A	lb/bu	no./lb	%	
	25	186,026	159	189	77	79	253	50.3	56.9	2,950	33.3	20.1
	50	211,825	159	189	78	82	253	46.6	57.2	2,931	33.6	19.9
26-Sep	75	203,678	159	189	80	84	253	50.1	57.2	2,924	33.5	19.9
	25	200,963	159	189	81	84	253	49.6	57.0	2,978	33.6	19.9
	50	203,226	159	189	80	84	253	50.6	56.9	2,937	33.5	20.1
1-Nov	75	204,131	159	189	79	77	253	47.0	57.1	2,964	33.4	20.0
CV (%)		11.2	0.1	0	5.6	6.3	0.1	10.0	0.5	3.6	0.7	0.8
LSD (0.10)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

In summary, the second year of research in this multi-year study indicates influence among rye seeding dates and rates on rye plant density the following spring. Early rye seeding provided foxtail and kochia suppression prior to soybean planting and rye termination. Also, performance of soybean was not affected by rye seeding date or rate.